TWILIGHT LIMB OBSERVATIONS OF AEROSOLS IN THE MARTIAN ATMOSPHERE BY MAVEN IUVS.

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Introduction: Aerosols in the Martian atmosphere play a fundamental role in controlling the climate of the Red Planet. By modifying the absorption and scattering of solar radiation at various altitudes, aerosols control the temperature profile in the atmosphere, driving circulations that result in a variety of effects, including a reduction of CO_2 deposition onto the northern polar cap during winter [1], a weakening of a diurnal tide [2], an increase in H_2O density in the middle atmosphere [3,4], and possibly an enhancement of the hydrogen corona [5,6]. Now these circulations are also responsible for the transport of aerosols and the mobilization of dust from the surface to form aerosols [7], thus completing a feedback loop. The study of these aerosols can provide insights into the role of aerosols and the other processes they control or controlling them in this feedback system.

The effects of aerosols in the Martian atmosphere have been extensively studied through the use of global circulation models (GCMs), often manifesting as a dust loading parameter in the models. However, these GCMs ultimately have to be grounded by empirical data, but limitations due to observation geometry of the various spacecraft at Mars has restricted the coverage available for validating the models. One important yet particularly understudied region is the middle atmosphere, corresponding to an altitude range of 60–130 km. In addition to being the upper extent of aerosols in the atmosphere, the middle atmosphere contains two important boundaries: the mesopause corresponding to a change in atmospheric heating from infrared emissions due to CO_2 and aerosols to solar ultraviolet radiation, and the homopause corresponding a change in atmospheric chemistry. Finally, the middle atmosphere serves as the connection between the lower atmosphere and the exosphere, controlling the rate at which light species are transported upwards to be lost in the exosphere.

The Imaging UltraViolet Spectrograph (IUVS) on the Mars Atmosphere and Volatile EvolutioN (MAVEN) mission has provided superior spatio-temporal coverage of the middle atmosphere from its dedicated limb observations since its arrival at Mars. About the apoapses (~6250 km) of each highly elliptical orbit, IUVS is pointed back towards at Mars and slit of the instrument is swept over the planetary disk to create images of the planet, including the atmospheric limb [8]. On many occasions, we observe significant sunlight being scattered over the limb into the nightside of the planet, and we attribute this scattering to aerosols.

Observations and Analyses: We investigate the the scattering of sunlight by aerosols over the limb using IUVS apoapse images. The observations used in our study are from orbits 1050–1082 (2015 April 15–21), which exhibit significant scattered sunlight over the limb. While the entire limb is captured in the image, we focus only on studying the section of the limb on the nightside. Generally for all the observations, the limb is slightly past the terminator, with solar zenith angles of ~110° at the tangent point of the instrument line-of-sight, and the line-of-sight intersecting the terminator at ~200 km altitude.

We make use of a single-scattering model to determine the vertical distribution of aerosols that would produce the observed intensities of scattered sunlight over the limb. We also assume the aerosol distribution to be horizontally uniform. Overall, the model provides a good first characterization of the aerosol distribution. We also discuss some possible reasons for the discrepancies between the observations and the modeled intensities.

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